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AF/2800 #

Docket No. 60,246-160
10408

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Kolk, et al.
Serial No.:	10/067,103
Filed:	02/04/2002
Group Art Unit:	2863
Examiner:	Shah, Kamini S.
Title:	TEMPERATURE CONTROL BALANCING DESIRED COMFORT WITH ENERGY COST SAVINGS

APPEAL BRIEF

Mail Stop Appeal Brief - Patent
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

The Notice of Appeal in this application was filed on December 12, 2003. Appellant now submits its brief in the above-referenced application. A check in the amount of $330.00 is enclosed. The Commissioner is authorized to charge Deposit Account No. 50-1482 in the name of Carlson, Gaskey & Olds for any additional fees or credit the account for any overpayment.

Real Party in Interest

Carrier Corporation is the real party in interest.

Related Appeals and Interferences

There are no related appeals or interferences.

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Status of the Claims

Claims 1-6, 9 and 11-14 stand rejected under 35 U.S.C. §102(e). The Examiner has already admitted that claims 7, 8, 10 and 15-18 contain allowable subject matter.

Status of Amendments

There are no unentered amendment.

Summary of the Invention

Temperature control arrangements for buildings typically include a thermostat device that allows an individual to choose a setpoint temperature so that a heating or cooling system will operate to compensate for any difference in the actual temperature and the setpoint temperature. Recent advances in thermostat devices include programmable thermostats that allows individuals to set different setpoint temperatures for different days and times of the day. (Page 1, paragraph 2).

Recently it has become more common for energy providers to change energy costs at different times responsive to the amount of usage or particular temperature extremes, for example. Conventional thermostat arrangements are not capable of addressing an individual's need or desire to realize energy cost savings in the face of changing energy prices. (Page 1, paragraph 3).

This invention provides an improved temperature controlling system that automatically adjusts the performance of the system based upon changes in energy pricing according to an individual's indicated preference for balancing energy cost savings with the desired temperature levels. In a disclosed example, a temperature regulating system 20 includes a thermostat device 26. One feature of the example thermostat device 26 is a display 28 that allows an individual to view items such as current setpoint temperature, current measured temperature, etc. A user interface 30,

such as a keypad, allows the user to input information such as a desired setpoint temperature and a preference regarding maintaining a comfortable temperature or saving costs. (Page 4, paragraph 15).

Another feature of the example thermostat device is a communication module that is capable of communicating with a remotely located outside source 40. The communication module is capable of obtaining pricing information, for example. In a disclosed example, when an energy company or another outside source changes the cost or pricing of energy supplied to run the system 20, the controller 32 gathers the price change information and utilizes that to determine whether the system operation should be altered to accommodate an individual's pre-selected preference for balancing temperature comfort levels with energy cost savings. (Paragraphs 18 and 19).

The controller utilizes a variety of pieces of information to determine a performance index value indicating the effect of the current energy price level and how the system should be operated, given the user's specified preference level for maintaining temperature comfort compared to maintaining energy cost savings. The performance index expresses the relationship between the need to maintain a setpoint temperature and the need to maintain energy cost savings, which accommodates the user's preference. The disclosed example includes using an optimal control solution to solve for the performance index value. (Paragraphs 27 and 29).

Accordingly, the performance index is a factor that is used to balance between maintaining a user selected setpoint temperature and maintaining energy consumption within a desired cost range, for example. The operation of the system (i.e., the sensitivity of the system to a difference between the setpoint temperature and a current actual temperature), can be adjusted based upon the performance index.

One disclosed control solution balances the sometimes competing interests in maintaining temperature comfort levels and maintaining energy costs savings as the cost of the energy changes. The user is able to provide information indicating the user's preference for maintaining a setpoint temperature compared to maintaining energy costs savings. In one example, a parameter Q is used to indicate the weight given by the individual to the desire to maintain the setpoint temperature. A relatively high Q value indicates a strong preference for maintaining temperature, regardless of energy cost savings implications. On the other hand, a relatively low Q value indicates that the individual prefers energy cost savings over maintaining the setpoint temperature. (Paragraph 22).

Another item of information used by the example controller is a nominal cost of energy R_n. This parameter indicates a base price of energy used by the controller for making performance index value calculations. The R_n value in one example is used to determine an energy penalty factor R indicating the weight given to the preference to save energy. In one example, R_n is chosen so that the R values will be on the same order of magnitude as Q (i.e., within a factor of 10). The energy penalty factor is defined by the equation R = current energy price/R_n. (Paragraph 23).

When the controller 32 determines an R value, as the price of energy goes up, the R value increases. When the R value is larger than the Q value, the need to save energy cost outweighs the need to maintain the setpoint temperature. Likewise, when the energy cost is relatively low, and the Q value is larger than the R value, the controller 32 causes the system 24 to operate in a manner that is consistent with a preference for maintaining the setpoint temperature over a desire to maintain energy cost savings. (Paragraph 24).

Independent claim 1 recites a method for controlling a temperature regulating system that includes, in part, defining a performance index that indicates a desired balance between maintaining

a user selected setpoint temperature and conserving energy cost. A value of the performance index is determined based upon a current energy cost. A sensitivity of the system to a difference between the setpoint temperature and a current actual temperature is adjusted according to the performance index value. Dependant claims 2-10 recite various techniques for accomplishing that end.

Independent claim 11 recites a temperature regulating system including a thermostat device and a communication module that is capable of receiving information from an outside source. A controller determines a current energy price from information received by the communication module. The controller determines a performance index value indicative of a user-specified desired balance between maintaining the setpoint temperature and energy cost savings. The controller automatically adjusts a sensitivity of the system to a difference between a current temperature and a setpoint temperature according to the performance index value. Dependent claims 12-18 recite various further details regarding a system designed according to an embodiment of this invention.

Issues

Whether the rejection under 35 U.S.C. §102(e) is proper where there is no discussion in the cited reference of a performance index value that indicates a desired balance between maintaining a selected setpoint temperature and conserving energy cost when every claim includes such a performance index value.

Grouping of Claims

Claims 7, 8, 10 and 15-18 contain subject matter that is already admitted to be allowable. Those claims are not on appeal.

The rejection of claims 1-6, 9 and 11-14 is contested. Every one of the rejected claims stand alone for purposes of this appeal.

Argument

INTRODUCTION

There is no anticipation because the reference relied upon by the Examiner is completely void of any mention of using a desired balance between maintaining a user selected setpoint temperature and conserving energy costs in a manner that is even remotely close to that which is claimed.

THE CITED REFERENCE

A. United States Patent No. 6,439,469 ("the *Gruber* reference")

The *Gruber* reference discloses an arrangement for predicting necessary values over a time horizon (i.e., a time during which the control values will be used). The Examiner relies upon the *Gruber* reference and points to column 2, lines 48-55; column 4, lines 11-27 and column 11, lines 57-column 12, line 9. Those portions are quoted in sequence below:

> Inputs to the flow temperature control 2 are the flow temperature reference value T_VRL calculated by the predictive controller 1, and the temperature return flow T_RL.
>
> ***The task of the predictive controller 1 is now to control the control values***-here, the flow temperature over a pre-determined time horizon, ***such that the inside temperature T-int in the room/building 3 satisfies the specifications of the user***.
>
> ...
>
> The task of the optimizing module 14 is to forecast from the forecast outside temperature T_ext_pred, the room occupancy calculated in advance occupancy_pred, the

filtered inside temperature T_int_obs, the current inside temperature T_int measured or calculated from the model, and from the room model of the controller including the parameters belonging to it, the inside temperature development T_int_pred and flow temperature development over the time horizon. The flow temperature profile to be calculated, advantageously composed of T_VRL and T_VRL-pred, has to be determined such that a cost function is optimized, and at the same time additional physically-based conditions are taken into account, so that a compromise between energy and cost optimization is obtained. The conditions relate to the flow and inside temperatures calculated in advance. The first value of the output profile T_VRL is then set.

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The following performance index should be minimized in the LP (linear programming) instance:

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As the room temperature is already adjusted by means of the restrictions, only the future flow temperatures T_VRL-pred are weighted, which correspond to the last n elements of the optimizing structure. Because of the different lengths of the time intervals within the time horizon, the flow temperatures are also to be weighted correspondingly (energy costs remain the same). (Emphasis added).

As can be seen, although oblique reference to "a compromise between energy and cost optimization" is made, the *Gruber* reference is void of any mention of utilizing an individual's preference for a desired balance between the sometimes competing factors of maintaining a selected setpoint temperature and maintaining energy cost savings. The *Gruber* controller only "satisfies the specifications of the user" by maintaining the setpoint temperature. The *Gruber* reference does not have a performance index as claimed. Although the words "performance index" are in the text, the performance index of the *Gruber* reference has nothing to do with the performance index of Applicants' claimed invention.

THE REJECTION UNDER 35 U.S.C. §102(e)

The Examiner relies upon the *Gruber* reference and states, "*Gruber* defines a performance index as desired temperature by user as in column 2, lines 48-55, and further defines on column 11, lines 57-line 9, column 12." This is where the Examiner begins and this is where the Examiner begins to go wrong. The *Gruber* reference never defines a "performance index" as indicated by the Examiner. Even if it did, that is not the same as the performance index of Applicant's claimed invention. The claimed performance index is not a setpoint temperature. Instead, it is an indication of a desired balance between maintaining a setpoint temperature and cost savings.

There is nothing within the *Gruber* reference that even hints at or suggests a performance index as defined in Applicant's claims. There is nothing within the *Gruber* reference that utilizes an individual's pre-selected balancing between saving energy costs and maintaining a selected temperature. As detailed below, each claim contains limitations that can nowhere be found in the *Gruber* reference. None of the claims are anticipated.

CLAIM 1 IS ALLOWABLE

Claim 1 recites, in part, "defining a performance index that indicates a desired balance between maintaining a user selected setpoint temperature and conserving energy costs." Claim 1 further recites that a value of the performance index is determined using an optimal control solution and a determined energy cost. Claim 1 concludes with, "adjusting a sensitivity of the system to a difference between a setpoint temperature and a current actual temperature according to the performance index value." None of this can be found in the *Gruber* reference. At best, the *Gruber*

reference obliquely mentions a "performance index" and a "compromise between energy and cost optimization." Even if those statements suggest some form of temperature control strategy, the quoted portions from the *Gruber* reference have no direct relationship and, therefore, cannot possibly be the same as the performance index of claim 1.

CLAIM 2 IS ALLOWABLE

Claim 2 further recites, "reducing the sensitivity when the performance index value indicates that conserving energy costs is preferable to maintaining the user-selected setpoint temperature based upon the current energy cost." This is nowhere disclosed in the *Gruber* reference. The only mention in the *Gruber* reference of the function of the predictive controller that has anything to do with what is recited in claim 2 is in column 2 at lines 51-55 where the *Gruber* reference teaches that the predictive controller "satisfies the specifications of the user." In other words, the *Gruber* reference is limited to making the system work to accommodate a user-selected setpoint temperature. There is never any discussion of reducing the sensitivity of the system or taking into account whether conserving energy cost would be preferable to maintaining the user-selected setpoint temperature. Claim 2 cannot possibly be anticipated by the *Gruber* reference.

CLAIM 3 IS ALLOWABLE

Claim 3 depends from claim 2 and further recites, "subsequently increasing the sensitivity when the performance index value changes because the current energy cost is relatively lower." This further modification is nowhere shown nor even possibly suggested within the *Gruber* reference.

CLAIM 4 IS ALLOWABLE

Claim 4 depends from claim 1 and includes the recitation, "reducing the sensitivity responsive to an increase in the energy cost." The *Gruber* never teaches this. While the *Gruber* reference does discuss in an oblique manner a cost function and a compromise between energy and cost optimization, there is nothing in *Gruber* that teaches reducing the sensitivity of the system when an increase in the energy cost is determined. Claim 4 is not anticipated.

CLAIM 5 IS ALLOWABLE

Claim 5 depends from claim 4 and more particularly recites, "adjusting a time within which the system reacts to the temperature difference," which is the difference between the setpoint temperature and the actual temperature in the area of interest. The only discussion of time in the *Gruber* reference is the "time horizon," which is the time period over which the predictive controller is to predict control values. There is no discussion of adjusting a time within which the system reacts to the claimed temperature difference. The claimed arrangement can slow down the amount of energy consumption, for example, by having a longer delay between a detected temperature difference and system response to change that difference, depending on the claimed performance index value. *Gruber* is void of any such teaching and claim 5 cannot be anticipated.

CLAIM 6 IS ALLOWABLE

Claim 6 depends from claim 4 and includes, "automatically at least temporarily resetting the setpoint temperature responsive to the performance index value." There is nothing within the *Gruber* reference that talks about resetting a setpoint temperature. Instead, at best, *Gruber*

"satisfies the specifications of the user." There is nothing within *Gruber* that possibly can be construed as anticipating claim 6.

CLAIM 9 IS ALLOWABLE

Claim 9 depends from claim 1 and includes, "using the performance index value to determine a gain value and applying the gain value to the system control signal." There is nothing within the *Gruber* reference that can be construed as the gain value of claim 9, let alone the performance index value that is absent from *Gruber*.

CLAIM 11 IS ALLOWABLE

Independent claim 11 recites a temperature regulating system that includes, in part, "a controller that determines a current energy price from information received by the communication module, determines a performance index value indicative of a balance between a user-specified desire to maintain the setpoint temperature and energy cost savings and automatically adjusts a sensitivity of the system to a difference between a current temperature and a setpoint temperature according to the performance index value." The *Gruber* reference does not contain such a controller. There is no use of current energy price information from a communication module in *Gruber*. There is no performance index value indicative of a balance between a user-specified desire to maintain the setpoint performance and energy cost savings in *Gruber*. There is no automatic adjustment of a sensitivity of the system in *Gruber*. If even one limitation is missing, there is no anticipation. In this instance, none of the just-quoted claim limitations can be found in *Gruber*. It is impossible for *Gruber* to be interpreted in a manner to anticipate claim 11.

CLAIM 12 IS ALLOWABLE

Claim 12 recites one way of adjusting a sensitivity of the system by including a controller that, "automatically slows down a response time of the system to the temperature difference responsive to an increase in energy cost." There is no such controller in the *Gruber* reference. There is no automatic slowing down of a response time in the *Gruber* reference. Further, there is no use of an increase in energy cost to provide such a change.

CLAIM 13 IS ALLOWABLE

Claim 13 depends from claim 11 and recites, "the controller automatically at least temporarily resets the setpoint temperature responsive to an increase in energy costs." There is no resetting of a setpoint temperature in the *Gruber* reference and claim 13 cannot be anticipated.

CLAIM 14 IS ALLOWABLE

Claim 14 recites that the controller "automatically adjusts a gain of a control value that directs an amount of air flow through the system according to the performance index value." There is no adjustment of such a gain and no performance index value as recited in the claim found in the *Gruber* reference. Claim 14 cannot be anticipated.

CONCLUSION

Not one claim is anticipated by the *Gruber* reference. There is no discussion in the *Gruber* reference of balancing between maintaining a setpoint temperature and maintaining cost savings based upon a user's expressed desire for how to balance those two, sometimes competing factors. As pointed out above, each claim has more than one limitation that cannot be found in the *Gruber* reference.

All claims are allowable. The rejection must be reversed.

Respectfully submitted,

CARLSON, GASKEY & OLDS, P.C.

February 13, 2004
Date

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CERTIFICATE OF MAIL

I hereby certify that the enclosed **Appeal Brief (in triplicate) and Fees** is being deposited with the United States Postal Service as First Class Mail, postage prepaid, in an envelope addressed to Mail Stop Appeal Brief - Patents , Commissioner For Patents, P. O. Box 1450, Alexandria, VA 22313-1450 on February 13, 2004.

Theresa M. Palmateer

APPENDIX OF CLAIMS

1. A method of controlling a temperature regulating system, comprising the steps of:

defining a performance index that indicates a desired balance between maintaining a user selected setpoint temperature and conserving energy costs;

determining a current energy cost;

determining a value of the performance index using an optimal control solution and the current energy cost; and

adjusting a sensitivity of the system to a difference between the setpoint temperature and a current actual temperature according to the performance index value.

2. The method of claim 1, including reducing the sensitivity when the performance index value indicates that conserving energy costs is preferable to maintaining the user-selected setpoint temperature based upon the current energy cost.

3. The method of claim 2, including subsequently increasing the sensitivity when the performance index value changes because the current energy cost is relatively lower.

4. The method of claim 1, including reducing the sensitivity responsive to an increase in the energy cost.

5. The method of claim 4, including adjusting the sensitivity by adjusting a time within which the system reacts to the temperature difference.

6. The method of claim 4, including automatically at least temporarily resetting the setpoint temperature responsive to the performance index value.

7. The method of claim 1, including determining the performance index by estimating a value of $PI = \int_{0}^{\infty} (QT^2+Ru^2)\, du$

wherein Q is a user-selected weighting factor indicating the user's desire to maintain the setpoint temperature;

T is the temperature difference;

R is a determined weighting factor indicating the need to balance energy cost savings with the user's desire to maintain the setpoint temperature; and

u is a value indicating system operation responsive to the temperature difference.

8. The method of claim 7, including estimating the performance index using a degenerate Ricatti equation.

9. The method of claim 1, including using the performance index value to determine a gain value and applying the gain value to the system control signal.

10. The method of claim 9, including determining the gain value by determining a value of $k^T = -PBR^{-1}$

wherein k is the gain value;

P is the estimated performance index value;

B is a predetermined system gain value; and

R is a determined weighting factor indicating the need to balance energy cost savings with the user's desire to maintain the setpoint temperature.

11. A temperature regulating system, comprising:

a thermostat device having a user input portion that allows a user to input a setpoint temperature and a sensor portion that provides an indication of a current temperature near the thermostat device;

a communication module that is capable of receiving information from an outside source remote from the thermostat device; and

a controller that determines a current energy price from information received by the communication module, determines a performance index value indicative of a balance between a user-specified desire to maintain the setpoint temperature and energy cost savings and automatically adjusts a sensitivity of the system to a difference between the current temperature and the setpoint temperature according to the performance index value.

12. The system of claim 11, wherein the controller automatically slows down a response time of the system to the temperature difference responsive to an increase in energy costs.

13. The system of claim 11, wherein the controller automatically at least temporarily resets the setpoint temperature responsive to an increase in energy costs.

14. The system of claim 11, wherein the controller automatically adjusts a gain of a control value that directs an amount of airflow through the system according to the performance index value.

15. The system of claim 11, wherein the controller determines the gain value by determining a value of $k^T = -PBR^{-1}$

wherein k is the gain value;

P is the estimated performance index value;

B is a predetermined system gain value; and

R is a determined weighting factor indicating the need to balance energy cost savings with the user's desire to maintain the setpoint temperature.

16. The system of claim 11, wherein the controller determines the performance index by estimating a value of $PI = \int_0^\infty (QT^2+Ru^2)\,du$

wherein Q is a user-selected weighting factor indicating the user's desire to maintain the setpoint temperature;

T is the temperature difference;

R is a determined weighting factor indicating the need to balance energy cost savings with the user's desire to maintain the setpoint temperature; and

u is a value indicating system operation responsive to the temperature difference.

17. The system of claim 16, wherein the controller estimates the performance index using a degenerate Ricatti equation.

18. The system of claim 16, wherein R is a ratio of the current energy price to a predetermined nominal energy price.

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Recently it has become more common for energy providers to change energy costs at different times responsive to the amount of usage or particular temperature extremes, for example. Conventional thermostat arrangements are not capable of addressing an individual's need or desire to realize energy cost savings in the face of changing energy prices. (Page 1, paragraph 3).

This invention provides an improved temperature controlling system that automatically adjusts the performance of the system based upon changes in energy pricing according to an individual's indicated preference for balancing energy cost savings with the desired temperature levels. In a disclosed example, a temperature regulating system 20 includes a thermostat device 26. One feature of the example thermostat device 26 is a display 28 that allows an individual to view items such as current setpoint temperature, current measured temperature, etc. A user interface 30,

such as a keypad, allows the user to input information such as a desired setpoint temperature and a preference regarding maintaining a comfortable temperature or saving costs. (Page 4, paragraph 15).

Another feature of the example thermostat device is a communication module that is capable of communicating with a remotely located outside source 40. The communication module is capable of obtaining pricing information, for example. In a disclosed example, when an energy company or another outside source changes the cost or pricing of energy supplied to run the system 20, the controller 32 gathers the price change information and utilizes that to determine whether the system operation should be altered to accommodate an individual's pre-selected preference for balancing temperature comfort levels with energy cost savings. (Paragraphs 18 and 19).

The controller utilizes a variety of pieces of information to determine a performance index value indicating the effect of the current energy price level and how the system should be operated, given the user's specified preference level for maintaining temperature comfort compared to maintaining energy cost savings. The performance index expresses the relationship between the need to maintain a setpoint temperature and the need to maintain energy cost savings, which accommodates the user's preference. The disclosed example includes using an optimal control solution to solve for the performance index value. (Paragraphs 27 and 29).

Accordingly, the performance index is a factor that is used to balance between maintaining a user selected setpoint temperature and maintaining energy consumption within a desired cost range, for example. The operation of the system (i.e., the sensitivity of the system to a difference between the setpoint temperature and a current actual temperature), can be adjusted based upon the performance index.

One disclosed control solution balances the sometimes competing interests in maintaining temperature comfort levels and maintaining energy costs savings as the cost of the energy changes. The user is able to provide information indicating the user's preference for maintaining a setpoint temperature compared to maintaining energy costs savings. In one example, a parameter Q is used to indicate the weight given by the individual to the desire to maintain the setpoint temperature. A relatively high Q value indicates a strong preference for maintaining temperature, regardless of energy cost savings implications. On the other hand, a relatively low Q value indicates that the individual prefers energy cost savings over maintaining the setpoint temperature. (Paragraph 22).

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When the controller 32 determines an R value, as the price of energy goes up, the R value increases. When the R value is larger than the Q value, the need to save energy cost outweighs the need to maintain the setpoint temperature. Likewise, when the energy cost is relatively low, and the Q value is larger than the R value, the controller 32 causes the system 24 to operate in a manner that is consistent with a preference for maintaining the setpoint temperature over a desire to maintain energy cost savings. (Paragraph 24).

Independent claim 1 recites a method for controlling a temperature regulating system that includes, in part, defining a performance index that indicates a desired balance between maintaining

a user selected setpoint temperature and conserving energy cost. A value of the performance index is determined based upon a current energy cost. A sensitivity of the system to a difference between the setpoint temperature and a current actual temperature is adjusted according to the performance index value. Dependant claims 2-10 recite various techniques for accomplishing that end.

Independent claim 11 recites a temperature regulating system including a thermostat device and a communication module that is capable of receiving information from an outside source. A controller determines a current energy price from information received by the communication module. The controller determines a performance index value indicative of a user-specified desired balance between maintaining the setpoint temperature and energy cost savings. The controller automatically adjusts a sensitivity of the system to a difference between a current temperature and a setpoint temperature according to the performance index value. Dependent claims 12-18 recite various further details regarding a system designed according to an embodiment of this invention.

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INTRODUCTION

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THE CITED REFERENCE

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> The task of the optimizing module 14 is to forecast from the forecast outside temperature T_ext_pred, the room occupancy calculated in advance occupancy_pred, the

filtered inside temperature T_int_obs, the current inside temperature T_int measured or calculated from the model, and from the room model of the controller including the parameters belonging to it, the inside temperature development T_int_pred and flow temperature development over the time horizon. The flow temperature profile to be calculated, advantageously composed of T_VRL and T_VRL-pred, has to be determined such that a cost function is optimized, and at the same time additional physically-based conditions are taken into account, so that a compromise between energy and cost optimization is obtained. The conditions relate to the flow and inside temperatures calculated in advance. The first value of the output profile T_VRL is then set.

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As can be seen, although oblique reference to "a compromise between energy and cost optimization" is made, the *Gruber* reference is void of any mention of utilizing an individual's preference for a desired balance between the sometimes competing factors of maintaining a selected setpoint temperature and maintaining energy cost savings. The *Gruber* controller only "satisfies the specifications of the user" by maintaining the setpoint temperature. The *Gruber* reference does not have a performance index as claimed. Although the words "performance index" are in the text, the performance index of the *Gruber* reference has nothing to do with the performance index of Applicants' claimed invention.

THE REJECTION UNDER 35 U.S.C. §102(e)

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There is nothing within the *Gruber* reference that even hints at or suggests a performance index as defined in Applicant's claims. There is nothing within the *Gruber* reference that utilizes an individual's pre-selected balancing between saving energy costs and maintaining a selected temperature. As detailed below, each claim contains limitations that can nowhere be found in the *Gruber* reference. None of the claims are anticipated.

CLAIM 1 IS ALLOWABLE

Claim 1 recites, in part, "defining a performance index that indicates a desired balance between maintaining a user selected setpoint temperature and conserving energy costs." Claim 1 further recites that a value of the performance index is determined using an optimal control solution and a determined energy cost. Claim 1 concludes with, "adjusting a sensitivity of the system to a difference between a setpoint temperature and a current actual temperature according to the performance index value." None of this can be found in the *Gruber* reference. At best, the *Gruber*

reference obliquely mentions a "performance index" and a "compromise between energy and cost optimization." Even if those statements suggest some form of temperature control strategy, the quoted portions from the *Gruber* reference have no direct relationship and, therefore, cannot possibly be the same as the performance index of claim 1.

CLAIM 2 IS ALLOWABLE

Claim 2 further recites, "reducing the sensitivity when the performance index value indicates that conserving energy costs is preferable to maintaining the user-selected setpoint temperature based upon the current energy cost." This is nowhere disclosed in the *Gruber* reference. The only mention in the *Gruber* reference of the function of the predictive controller that has anything to do with what is recited in claim 2 is in column 2 at lines 51-55 where the *Gruber* reference teaches that the predictive controller "satisfies the specifications of the user." In other words, the *Gruber* reference is limited to making the system work to accommodate a user-selected setpoint temperature. There is never any discussion of reducing the sensitivity of the system or taking into account whether conserving energy cost would be preferable to maintaining the user-selected setpoint temperature. Claim 2 cannot possibly be anticipated by the *Gruber* reference.

CLAIM 3 IS ALLOWABLE

Claim 3 depends from claim 2 and further recites, "subsequently increasing the sensitivity when the performance index value changes because the current energy cost is relatively lower." This further modification is nowhere shown nor even possibly suggested within the *Gruber* reference.

CLAIM 4 IS ALLOWABLE

Claim 4 depends from claim 1 and includes the recitation, "reducing the sensitivity responsive to an increase in the energy cost." The *Gruber* never teaches this. While the *Gruber* reference does discuss in an oblique manner a cost function and a compromise between energy and cost optimization, there is nothing in *Gruber* that teaches reducing the sensitivity of the system when an increase in the energy cost is determined. Claim 4 is not anticipated.

CLAIM 5 IS ALLOWABLE

Claim 5 depends from claim 4 and more particularly recites, "adjusting a time within which the system reacts to the temperature difference," which is the difference between the setpoint temperature and the actual temperature in the area of interest. The only discussion of time in the *Gruber* reference is the "time horizon," which is the time period over which the predictive controller is to predict control values. There is no discussion of adjusting a time within which the system reacts to the claimed temperature difference. The claimed arrangement can slow down the amount of energy consumption, for example, by having a longer delay between a detected temperature difference and system response to change that difference, depending on the claimed performance index value. *Gruber* is void of any such teaching and claim 5 cannot be anticipated.

CLAIM 6 IS ALLOWABLE

Claim 6 depends from claim 4 and includes, "automatically at least temporarily resetting the setpoint temperature responsive to the performance index value." There is nothing within the *Gruber* reference that talks about resetting a setpoint temperature. Instead, at best, *Gruber*

"satisfies the specifications of the user." There is nothing within *Gruber* that possibly can be construed as anticipating claim 6.

CLAIM 9 IS ALLOWABLE

Claim 9 depends from claim 1 and includes, "using the performance index value to determine a gain value and applying the gain value to the system control signal." There is nothing within the *Gruber* reference that can be construed as the gain value of claim 9, let alone the performance index value that is absent from *Gruber*.

CLAIM 11 IS ALLOWABLE

Independent claim 11 recites a temperature regulating system that includes, in part, "a controller that determines a current energy price from information received by the communication module, determines a performance index value indicative of a balance between a user-specified desire to maintain the setpoint temperature and energy cost savings and automatically adjusts a sensitivity of the system to a difference between a current temperature and a setpoint temperature according to the performance index value." The *Gruber* reference does not contain such a controller. There is no use of current energy price information from a communication module in *Gruber*. There is no performance index value indicative of a balance between a user-specified desire to maintain the setpoint performance and energy cost savings in *Gruber*. There is no automatic adjustment of a sensitivity of the system in *Gruber*. If even one limitation is missing, there is no anticipation. In this instance, none of the just-quoted claim limitations can be found in *Gruber*. It is impossible for *Gruber* to be interpreted in a manner to anticipate claim 11.

CLAIM 12 IS ALLOWABLE

Claim 12 recites one way of adjusting a sensitivity of the system by including a controller that, "automatically slows down a response time of the system to the temperature difference responsive to an increase in energy cost." There is no such controller in the *Gruber* reference. There is no automatic slowing down of a response time in the *Gruber* reference. Further, there is no use of an increase in energy cost to provide such a change.

CLAIM 13 IS ALLOWABLE

Claim 13 depends from claim 11 and recites, "the controller automatically at least temporarily resets the setpoint temperature responsive to an increase in energy costs." There is no resetting of a setpoint temperature in the *Gruber* reference and claim 13 cannot be anticipated.

CLAIM 14 IS ALLOWABLE

Claim 14 recites that the controller "automatically adjusts a gain of a control value that directs an amount of air flow through the system according to the performance index value." There is no adjustment of such a gain and no performance index value as recited in the claim found in the *Gruber* reference. Claim 14 cannot be anticipated.

CONCLUSION

Not one claim is anticipated by the *Gruber* reference. There is no discussion in the *Gruber* reference of balancing between maintaining a setpoint temperature and maintaining cost savings based upon a user's expressed desire for how to balance those two, sometimes competing factors. As pointed out above, each claim has more than one limitation that cannot be found in the *Gruber* reference.

All claims are allowable. The rejection must be reversed.

Respectfully submitted,

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February 13, 2004
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CERTIFICATE OF MAIL

I hereby certify that the enclosed **Appeal Brief (in triplicate) and Fees** is being deposited with the United States Postal Service as First Class Mail, postage prepaid, in an envelope addressed to Mail Stop Appeal Brief - Patents , Commissioner For Patents, P. O. Box 1450, Alexandria, VA 22313-1450 on February 13, 2004.

Theresa M. Palmateer

APPENDIX OF CLAIMS

1. A method of controlling a temperature regulating system, comprising the steps of:

defining a performance index that indicates a desired balance between maintaining a user selected setpoint temperature and conserving energy costs;

determining a current energy cost;

determining a value of the performance index using an optimal control solution and the current energy cost; and

adjusting a sensitivity of the system to a difference between the setpoint temperature and a current actual temperature according to the performance index value.

2. The method of claim 1, including reducing the sensitivity when the performance index value indicates that conserving energy costs is preferable to maintaining the user-selected setpoint temperature based upon the current energy cost.

3. The method of claim 2, including subsequently increasing the sensitivity when the performance index value changes because the current energy cost is relatively lower.

4. The method of claim 1, including reducing the sensitivity responsive to an increase in the energy cost.

5. The method of claim 4, including adjusting the sensitivity by adjusting a time within which the system reacts to the temperature difference.

6. The method of claim 4, including automatically at least temporarily resetting the setpoint temperature responsive to the performance index value.

7. The method of claim 1, including determining the performance index by estimating a value of $PI = \int_{o}^{\infty} (QT^2+Ru^2)\, du$

wherein Q is a user-selected weighting factor indicating the user's desire to maintain the setpoint temperature;

T is the temperature difference;

R is a determined weighting factor indicating the need to balance energy cost savings with the user's desire to maintain the setpoint temperature; and

u is a value indicating system operation responsive to the temperature difference.

8. The method of claim 7, including estimating the performance index using a degenerate Ricatti equation.

9. The method of claim 1, including using the performance index value to determine a gain value and applying the gain value to the system control signal.

10. The method of claim 9, including determining the gain value by determining a value of $k^T = -PBR^{-1}$

wherein k is the gain value;

P is the estimated performance index value;

B is a predetermined system gain value; and

R is a determined weighting factor indicating the need to balance energy cost savings with the user's desire to maintain the setpoint temperature.

11. A temperature regulating system, comprising:

a thermostat device having a user input portion that allows a user to input a setpoint temperature and a sensor portion that provides an indication of a current temperature near the thermostat device;

a communication module that is capable of receiving information from an outside source remote from the thermostat device; and

a controller that determines a current energy price from information received by the communication module, determines a performance index value indicative of a balance between a user-specified desire to maintain the setpoint temperature and energy cost savings and automatically adjusts a sensitivity of the system to a difference between the current temperature and the setpoint temperature according to the performance index value.

12. The system of claim 11, wherein the controller automatically slows down a response time of the system to the temperature difference responsive to an increase in energy costs.

13. The system of claim 11, wherein the controller automatically at least temporarily resets the setpoint temperature responsive to an increase in energy costs.

14. The system of claim 11, wherein the controller automatically adjusts a gain of a control value that directs an amount of airflow through the system according to the performance index value.

15. The system of claim 11, wherein the controller determines the gain value by determining a value of $k^T = -PBR^{-1}$

wherein k is the gain value;

P is the estimated performance index value;

B is a predetermined system gain value; and

R is a determined weighting factor indicating the need to balance energy cost savings with the user's desire to maintain the setpoint temperature.

16. The system of claim 11, wherein the controller determines the performance index by estimating a value of $PI = \int_{o}^{\infty} (QT^2+Ru^2)\, du$

wherein Q is a user-selected weighting factor indicating the user's desire to maintain the setpoint temperature;

T is the temperature difference;

R is a determined weighting factor indicating the need to balance energy cost savings with the user's desire to maintain the setpoint temperature; and

u is a value indicating system operation responsive to the temperature difference.

17. The system of claim 16, wherein the controller estimates the performance index using a degenerate Ricatti equation.

18. The system of claim 16, wherein R is a ratio of the current energy price to a predetermined nominal energy price.

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